

Ecological Effects of Vehicular Routes in the Mojave Desert: State-of-Knowledge Review

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Literature Documenting Effects of Vehicular Routes in the Mojave Desert

- Few quantitative analyses of one-or two-lane vehicular routes in the Mojave Desert
- Numerous studies documenting effects of Off Highway Vehicles
- Many lack robust statistical design
- Literature from other North American desert regions can be extrapolated for application in the Mojave with care

Types of Vehicular Routes

- OHV trails
 - single-track motorcycle
 - two-track 4-wheel drive
- Local roads
 - unimproved dirt
 - improved dirt
- Collector roads
 - improved dirt
 - gravel
 - paved
- Arterial roads
 - State highways
- Limited-access highways
 - Interstate freeway
 - toll roads

Comparisons Among Vehicular Routes

Route type	Route Characteristics				
	Surface	Berms	Shoulders	Frequency of travel	Other factors
OHV trails	Single or two-track dirt	None	None	Low	Pervasive in wildlands, diffuse distribution
Local roads	1-lane dirt	Low	None	Low	Pervasive in wildlands
Collector roads	1 to 2-lane improved dirt, gravel, or paved	High	Narrow	Moderate	Pervasive in wildlands
Arterial roads	2-lane paved	High	Wider	High	Fencing, culverts
Limited-access highways	Multi-lane paved	High	Very Wide	Very High	Fencing, culverts, median

Vehicular Routes Effect Physical Features, Vegetation and Wildlife

Direct

- Geomorphology
- Hydrology
- Microclimate
- Invasive Plants
- Atmosphere
- Mortality due to Construction / Traffic
- Fire

Indirect

- Habitat fragmentation
 - Ecological barriers, corridors, and filters
- Changes in populations and community structure
- Access

Effects of Vehicular Routes on Mammals in the Mojave Desert

Garland and Bradley (1984)

- Rodents were abundant within approximately 30m of the highway but rarely crossed it
- Suggest that wide roads may inhibit crossings
- Found that size of home range did not effect proximity to highway

Starr (1998)

- Access is critical component to resistance to human impacts in desert ecosystems
- Ease of access results in high Cumulative Impact Ratings that decrease with increasing distance from the road, with no impacts found 3-4 km from edge of development

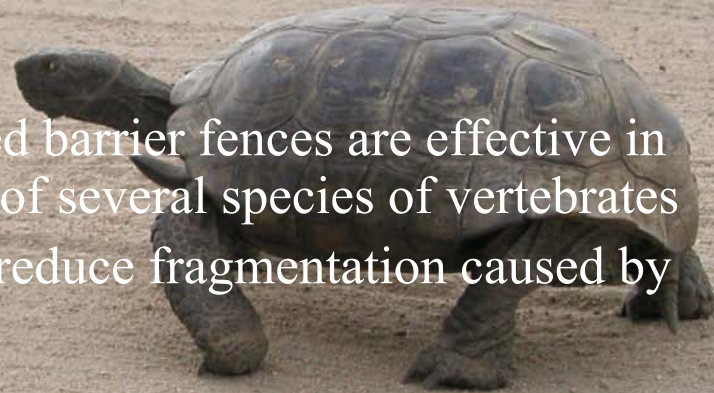
Effects of Fencing Vehicular Routes

Boarman and Sazaki (1997)

- New and properly maintained barrier fences are effective in reducing highway mortality of several species of vertebrates
- Yet to determine if culverts reduce fragmentation caused by highways and fences

Brooks (1995, 1999)

- Abundance and species richness of birds and lizards were higher inside than outside DTNA. Abundance of black tailed hares was lower inside DTNA
- Structural diversity of perennial plant community did not differ but total plant cover was 50% greater in protected areas
- Greater abundances and species richness of vertebrates inside may correlate with abundance of seeds and invertebrate prey



Effects of Vehicular Routes on Vegetation in the Mojave Desert

Hunter and Turner (1987)

- Clearing and construction replaced native annual plants with non-native species *E. cicutarium*, *S. arabicus* and *S. paulsenii*

Johnson et al., (1975)

- Arterial verge cover was 17x higher, and improved dirt roadside cover was 6x higher, than control areas
- Species richness of annual plants was higher along verges, especially along paved roads
- High density of annual plants along verges was due primarily to the natives *A. tessellata* and *D. pinnata*, and the aliens *B. rubens* and *S. barbatus*

OHV Activity Directly Correlated to Loss of Flora and Fauna

Davidson and Fox (1974)

- Herbaceous plant density was ~3x lower in the pit and trail areas, than control areas
- Soil compaction was highest in pit and trail areas
- Fibrous-rooted alien annual grasses (*Schismus* spp.) were more abundant in the pit and trail areas

Bury and Luckenbach (2002)

- Compared desert tortoise populations OHV area vs. unused area
- Perennial plant cover was 1.7x higher on unused plot
- Number, size of individuals and number and size of burrows was greater in unused areas

Effects of Utility Corridors

Lathrop & Archbold (1980)

- Construction decreased productivity, diversity and stability of perennial vegetation
- Measured increases in non-native vegetation
- Enhanced vegetation along road edges and slight increases under powerlines and along trenches of pipelines

Vasek et al. (1975)

- Perennial plant density and cover were significantly higher on the dirt road verge than the control area away from the verge
- Recovery of vegetation after utility construction may require a minimum of 30-40 years, likely longer

Chihuahuan and Sonoran Deserts

Lightfoot and Whitford (1991)

- Compared plant cover along roadsides and 20m from the roadsides
- Increased roadside creosote production
- Foliage arthropod densities were higher

Rosen and Lowe (1994)

- Measured roadside mortality of Sonoran Desert snakes
- Counted 368 snakes (104 live, 264 dead) / 4 yrs / 15, 525 km
- Estimated loss of 22.5/km/yr along 44km transect of paved road

Roads as Conduits for Exotic Plant Invasions: Colorado Plateau

Gelbard and Belnap (2003)

- Compared plant cover along the verges and 165ft from the verges (“interior sites”) of paved roads, improved dirt roads, and 4-wheel drive tracks
- Road improvement increased cover of alien plants in roadside verges
- Road improvement also increased alien plant cover in interior sites.
- In interior sites, alien species richness was more than 50% greater along paved roads and 30% lower along 4-wheel-drive tracks

What We do Know About Vehicular Routes and the Mojave Desert

- Road construction tends to decrease perennial plant cover and increase cover of non-native annual species
- Increase in vigor of roadside plants
- Increase in some species of foliage arthropods at the road verge
- Little research documents effects of vehicular routes on reptiles, amphibians or mammals

Directions for Future Research

- Studies compare road verges with areas some distance away, but very few have studied gradients
- Few studies have evaluated the relative effects of different types of vehicular routes
- Studies are needed to determine thresholds of route effects, and develop landscape models which are necessary for designing buffer zones around vehicular routes
- Roads can serve as barriers, corridors, and filters for plant and animal dispersal and invasions, but we know virtually nothing about how they affect species and communities in the Mojave Desert